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nest. Indeed, it would be difficult for them to do so, as their abdomens are so swollen by the honey they contain as to render locomotion a task of difficulty, if not to make it utterly impossible.

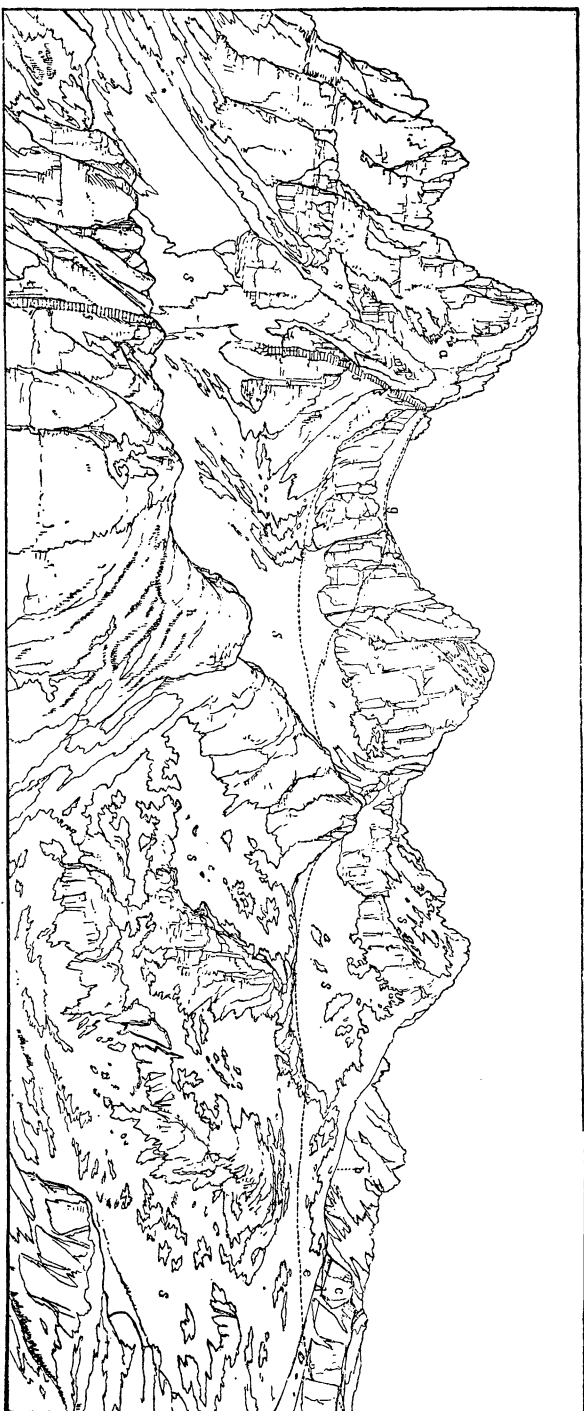
The workers (No. 1) provide them with a constant supply of flowers and pollen, which, by a process analogous to that of the bee, they convert into honey. That the remainder of the inhabitants feed on the supply thus obtained, though it is surmised, has not been established by actual observation; indeed, with reference to many of the habits of these creatures, we are in present left in total ignorance, it being a reasonable supposition that, in insects so remarkable in many of their habits, other interesting facts are yet to be brought to light respecting them. It would be of great value to learn the specific rank of the black workers (No. 3), and to know the sexes of the species forming the community, their season and manner of pairing, and whether the honey-makers are themselves used as food, or if they excrete their saccharine fluid for the benefit of the inhabitants in general, and then proceed to distil more. I regret that at this time I am only able to bring before the notice of the Academy, specimens of the honey-makers (No. 2), the other members of the community, except from Captain Fleeson's description, being quite unknown to me. It is, however, my hope that at a future meeting I may be enabled to exhibit the other varieties, and to give some more extended information upon this very interesting subject. The honey is much sought after by the Mexicans, who not only use it as a delicate article of food, but apply it to bruised and swollen limbs, ascribing to it great healing properties. The species is said to be very abundant in the neighborhood of Sante Fé, New Mexico, in which district the observations of Capt. Fleeson were made.

REVIEWS AND BOOK NOTICES.

THE SCENERY OF THE ROCKY MOUNTAINS AND ITS ORIGIN.—
Professor Hayden's last report* on the geology of the territories

*Sixth Annual Report of the United States Geological Survey of the Territories, embracing portions of Montana, Idaho, Wyoming and Utah; being a report of progress of the explorations for the year 1872. F. V. Hayden, U. S. Geologist. Washington, 1873. With plates and woodcuts. pp. 844.

Fig. 173.



Three Têtes, looking East.

a, Mount Hayden; *b*, Lake; *c*, Quebec Group Limestone; *d*, Quartzite; *e*, Granite; *f*, Trap Dyke; *g*, "Saddle"; *h*, Timber line, 9,000 ft.; Dotted line, course of ascent; *ss*, snow.

of Idaho, Montana and Utah comes to us stored with facts bearing upon the origin of the wonderful scenery of the Rocky Mountains. The mode of formation of the lofty peaks, of the vast abyssal cañons and broad lake valleys, together with the origin of the hot springs and geysers, the last remnants of the tremendous volcanic activity that pervaded this region, is discussed with more or less detail, by Prof. Hayden, whose sixteen years' experience as a geologist in the far west certainly enables him to speak with authority on these subjects.

One of the results of these surveys was the discovery and reservation of the National Park of the Yellowstone River. How tourists may enjoy its wonders and beauties will be solved, we are told, should the railroad which contemplates connecting Corinne, Utah, with Helena, Montana, pass up Henry's Fork. That accomplished, we are promised that "all the wonders of our great national park can be seen in one day's travel on horseback from this route."

We have before spoken in this journal of the fine photographs of the Téton Range published by the Survey. This group of peaks, which are more truly alpine in character than any other known in the west, have at length been ascended by Messrs. Stevenson and Langford, the only white men who have ever reached the summit. "Immense masses of snow and lakes of ice were found on its sides, and abundant signs of glacial action." The accompanying figure (175) gives an idea of the range and the course of ascent.

Another result of the season's (1872) work was the exploration and mapping out of the great water divide from which, in a radius of ten miles, the Missouri, the Green and Colorado Rivers, and the Snake and Columbia Rivers take their rise. A new geyser basin was discovered on Shoshone Lake, and found to be the true source of the Madison River, lying on the Pacific slope, between 7,000 and 8,000 feet above the sea, with surrounding peaks 10,000 to 12,000 feet high. The basin contained from seventy-five to one hundred springs, some being geysers of considerable power, while the peculiar ornamentation about them is considered more elaborate and interesting than the celebrated springs of the Fire Hole basin, an account of which we have already given our readers. These are the more prominent results of the season's work.

Of much economic interest is the great soft coal or lignitic formation of the west. From the researches of Messrs. Lesquereux, Meek and others, together with his own, Prof. Hayden infers that

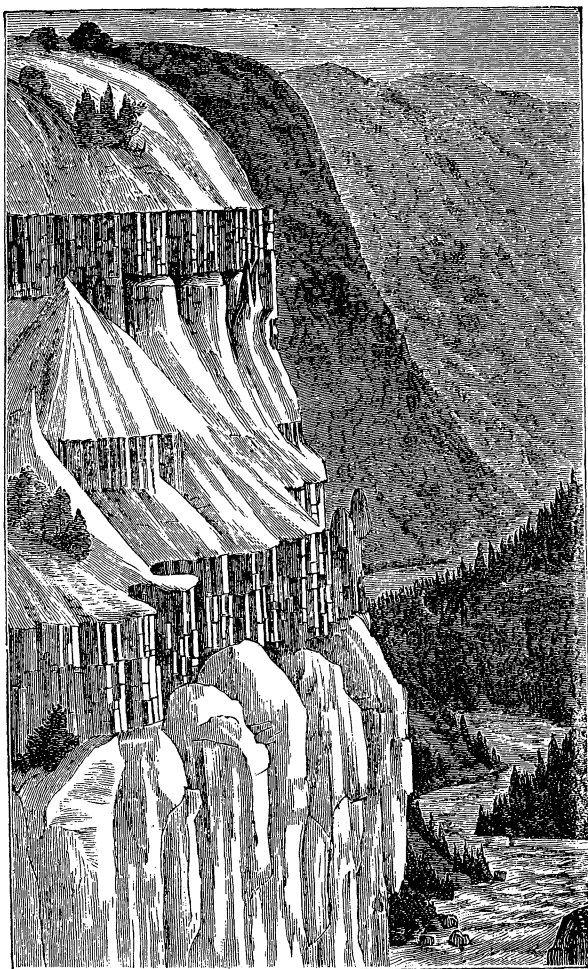
the deposition of these lignitic strata began during the latter portion of the Cretaceous period, and continued on into Tertiary times.

The origin of the Salt Lake valley, of which the remarkable Wahsatch Range forms the eastern boundary, seems due to a long continued erosion of a series of mountain chains spread over this area and resulting from a crumpling or folding of the earth's crust. "It is most probable that at a comparatively modern period the vast area between the Wahsatch Mountains on the east and the Sierra Nevada on the west was one great lake, the mountains rising up as islands in this vast inland sea. The lakes, large and small, which we find scattered over the basin at the present time, are only remnants of this former sea." Out of the flanks of these wrinkles in the earth's crust, cañons, with nearly vertical walls 1,000 to 2,000 feet high, have been carved by atmospheric agencies, such as ice, frost and water. "The valleys between these folds or ridges are synclinals, which have been deepened by erosion. The islands in Salt Lake are only the crests of these folds, while the waters occupy the synclinal valleys; and this remnant illustrates, on a small scale, the scenic beauty of the great inland sea when it extended over the entire basin."

Farther north in the Yellowstone valley are magnificent specimens of cañons whose mountain walls are formed of volcanic conglomerate 1,000 feet in thickness. Such a valley of erosion is represented by Fig. 176. In the mountains at the source of the East and Yellowstone rivers these conglomerates are sometimes 4,000 or 5,000 feet thick. These beds are supposed to have been "thrown out by volcanoes into the surrounding waters much as similar materials are injected from modern volcanoes at the present time." As these beds are horizontal and regularly stratified from base to summit, Prof. Hayden concludes "that at a comparatively modern date, the waters so covered these mountain ranges of the northwest, that not even the summits of the loftiest peaks were above the surface. It is barely possible that we might make an exception in the case of the Grand Tétos. We may suppose that the materials were supplied from the numberless volcanic fissures in unlimited quantities in a comparatively brief space of time; but the period which would be required for the waters to arrange this matter in the remarkably uniform and compact series of strata which we find at the present time must have been great.

The results have been carried on upon such a stupendous scale that the mind finds with difficulty the courage to grapple with them or attempt to explain them. And then, subsequent to the depo-

Fig. 176.

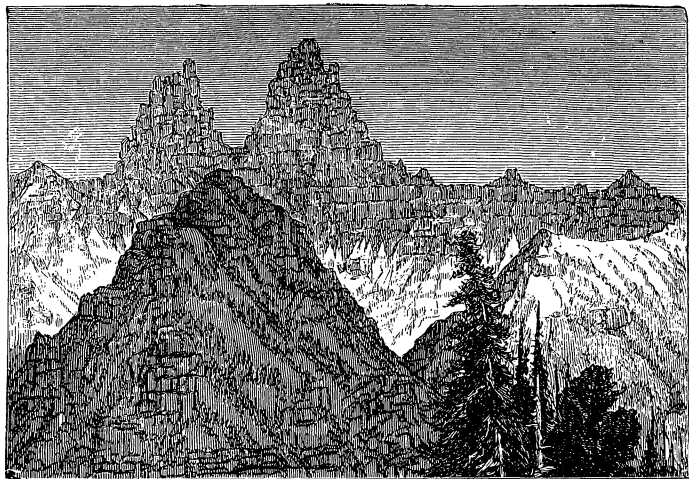


Basaltic Columns, Yellowstone, near mouth of Tower Creek.

sition of these enormous beds of conglomerates, has been the wearing out of cañons and valleys 2,000 to 4,000 feet in depth, the sculpturing of some of the most marvellously grand and unique

scenery on the continent. In passing up the valley of the upper Yellowstone, which is about three miles wide and has been carved out of this hard breccia, one could easily imagine himself in some enchanted land, where, on every side, were castles and palaces without number." Farther on our author concludes that "the erosive forces have acted on a more stupendous scale than he had ever before conceived of, and that the entire series of sedimentary strata, from the lowest Silurian to the highest Tertiary, known in the West, has extended in an unbroken mass all over the northwest; and we find here and there by the exposure of the entire series, as at Cinnabar Mountain, and in many other localities, the most satisfactory proof of the statement which I have so often made. This

Fig. 177.



Index and Pilot Peaks.

single statement implies that from 10,000 to 15,000 feet in thickness of unchanged rocks have been removed from this mountain region, except what might be called remnants left behind, occupying restricted areas."

The period of intensest volcanic activity culminated during the later Tertiary period. The mountains resulting have now assumed such forms as are shown in Fig. 177 of Index and Pilot Peaks, while Fig. 176 is an example of basaltic columns, the result of

overflows of lava, which forms the walls of the grand canon of the Yellowstone.

The last trace of this volcanic activity, for there are now no active volcanoes in Montana or Idaho, is seen in the numerous hot

Fig. 178.



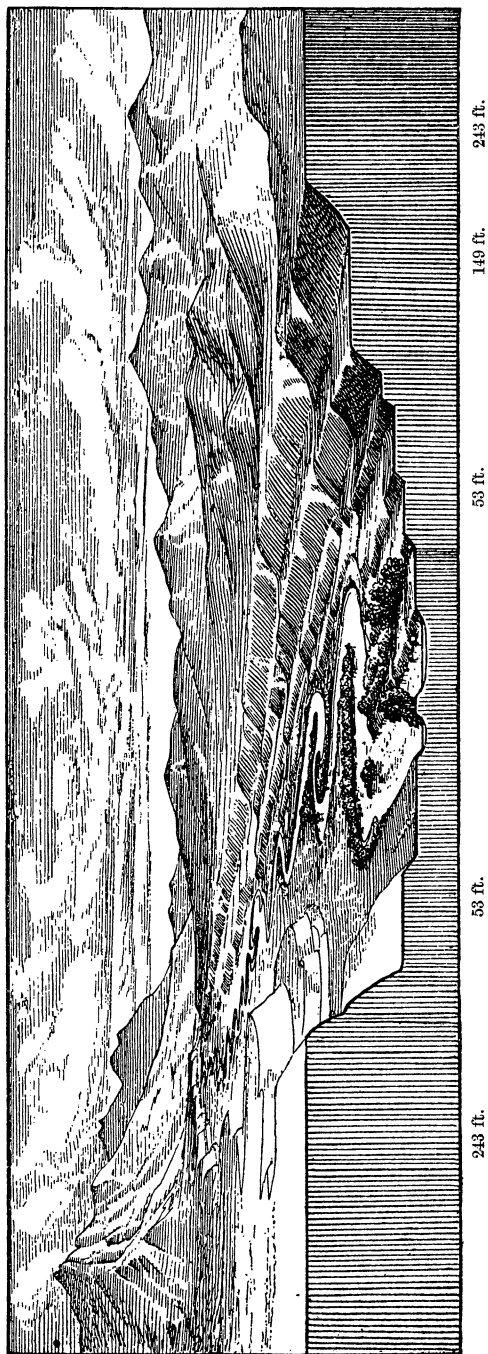
Extinct Geyser, East Fork of the Yellowstone.

springs or extinct geysers, in the valleys, of which Fig. 178 represents a good example. How this region was drained we will answer in the author's own words.

"We may conclude, not only that the carving out of the channel of the Grand Cañon was a very modern event, but that the deposition of the entire material which forms the cañon is, in a geological sense, quite a modern occurrence. The drainage of the country commenced long before the excavation of the present water-courses, but it is difficult to answer the question how this great drainage was brought about, unless we account for it by a general elevation of the entire country, gradually sending this immense body of water, which must have prevailed all over the northwest at least, perhaps all over the Rocky Mountain region, westward into the Pacific and eastward into the Atlantic. As the waters slowly subsided they were separated into lakes of greater or less size, and then came the excavation of the Grand Cañon, which slowly drained the great lake-basin above the falls so that now we have only the comparatively small remnant, the Yellowstone Lake. Other small fragments are scattered about in the vicinity, which now form reservoirs for the local drainage. Undoubtedly the same series of remarkable physical events occurred in Oregon and California and in Idaho and Washington Territories, and, perhaps, far southward into Mexico, judging from the published reports. The Hot Springs, which are now slowly dying out, are, of course, the last of this series of events. The evidence seems clear that all over the West, during this great period of volcanic activity, the hot springs and perhaps even geysers were very numerous. We everywhere find the remains or deposits in all the states and territories west of the Mississippi, and now and then a warm or hot spring remains to indicate the story of their former power."

How these valleys were eroded may be inferred from the following remarks. "On the west side of the Madison there are three or four peaks which are at least 10,000 feet high. Among these mountain-gorges we see the sources of the myriad small branches which, in the aggregate, form the large river. Nestled among the craggy cliffs are here and there little ponds of clear water, derived from the melting of the snows, seldom ever seen except by the birds and the game that visit them to quench their thirst. The tendency of all these gorges is to work their way inward toward the divide. Great masses of snow and ice accumulate in them during the winter ; and the water, flowing down among the fractured masses, freezes and expands with a force that year by year tears down a portion, which falls into the depths below and is swept down

Fig. 179.



by the torrent. The aggregate of the forces which have continued in operation through a series of ages, which no man can determine now, and which we agree to denominate meteoric or atmospheric, are the combined action of water, air and ice. These forces have undoubtedly been far more effective in ages past than at present."

One of the latest geological occurrences in this region, as well as over the world generally, is the formation of the terraces occasionally found bordering rivers. In a basin of the Madison River is a remarkable system of terraces represented by Fig. 179. While usually in the terraces of our eastern rivers, and in fact rivers generally, those on opposite sides are of unequal height, here each terrace is uniformly of the same height as the one opposite.

In Montana neither are the anticlinal folds or synclinal valleys so distinctly defined as in the interior basin of Utah, but the prominent features are the widely extended areas of elevation.

Geologists will be interested in a feature of the geological structure of the mountains of Montana, "observed by the survey of the past season for the first time and not noticed in such a marked degree in any other portions of the west." This is the inversion of the sedimentary beds, so that the oldest incline at a greater or less angle on those of more modern ages. The mode of formation of cañons and river valleys is reserved for future discussion, but attention is drawn to the "fact that the streams seem to have cut their way directly through mountain ranges, instead of following synclinal depressions." This, he says, indicates that they began the process of erosion at the time of the commencement of the elevation of the surface. "This is shown all along the valley of the Yellowstone and more conspicuously in the valleys of the Madison and Gallatin which have carved immense cañons or gorges directly through two of the loftiest ranges of mountains in Montana."

The action of glaciers in causing this erosion Prof. Hayden thinks to have been local, and he regards the superficial or drift deposits, which sometimes are very thick, as of local origin. "As I have so often stated in my previous reports, I have never been able to find any evidence in the Rocky Mountain region of what is usually termed a northern drift."

It will be seen how much geographers and geologists as well as lovers of the marvellous and beautiful in nature are indebted to

the liberality of our government in causing these explorations to be carried out, and in placing the results directly before the people. We shall return to this report in a subsequent number of this journal, and notice the results contributed by Prof. Hayden's collaborators.

After all, the discoveries here published are the results of but a slight reconnoissance, and we trust that this is but the beginning of a long series of annual explorations, so that the outlines here sketched may be filled in with a completeness worthy of the subject.

ELEMENTS OF PHYSICAL MANIPULATION.*—This book would, perhaps, have never seen the light, or even been conceived of in the olden time of endeavoring to instruct students by talking at them from behind a formidable array of retorts, balances and batteries. By the new method the student is invited into the laboratory, and initiated into the use of the apparatus, of old so mysterious and awe-inspiring to the beginner. The tools of the physicist and chemist are now explained and their use illustrated; and, equipped with a knowledge of manipulation, the learner needs little urging to apply his information.

This text book of physical manipulation seems admirably adapted to aid the teacher in work of this kind, and for those who have not the advantages of competent laboratory instruction it seems to us that it must prove invaluable. It is also admirably designed as an introduction to the ordinary text books.

Judging by the portion relating to the use of the microscope, the style is exact and clear. The spectroscope, both solar and chemical, is described, and experiments in its use given. So for the microscope. The instrument is described, and experiments illustrating its use given, also an account of the diaphragm, oblique illumination, the study of opaque objects, the lieberkuhn, Wenham's parabolic condenser, the achromatic condenser, the polariscope, binocular, Maltwood's finder, micrometer, goniometer, camera lucida, spectrum microscope, and test objects, together with concise directions for the preparation and mounting of objects, and directions for measuring the focal length of an objective.

Prof. Pickering claims that among the experiments, several that are new, with new apparatus, such as that for ruling scales, the

* *Elements of Physical Manipulation.* By Edward C. Pickering. New York. Hurd and Houghton. 1873. 8vo. pp. 225. \$3.00.